

European Space Operations Centre

PROCESS IMPROVEMENT AND RISK MITIGATION – QA/PA CONTRIBUTION TO MISSION COST REDUCTION

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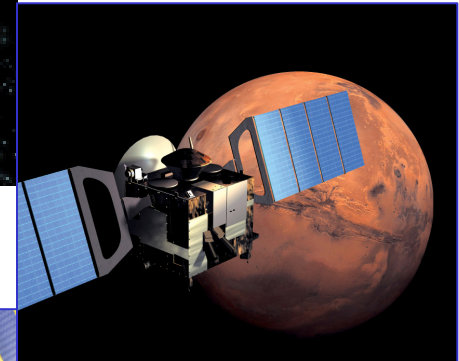
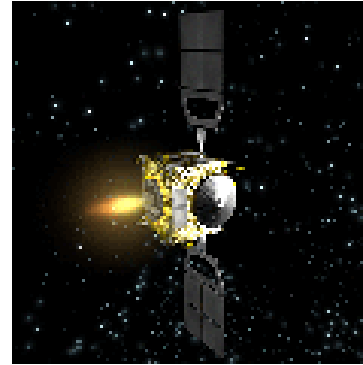


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Topics

- Background on ESOC / ESA
- Cost of Quality
- Process Standardization
- Process Improvement
- Trend and Distribution Analysis
- Risk Management
- Conclusion



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The European Space Operations Centre

Planning and execution
of satellite operations
for all mission phases

ESOC Darmstadt



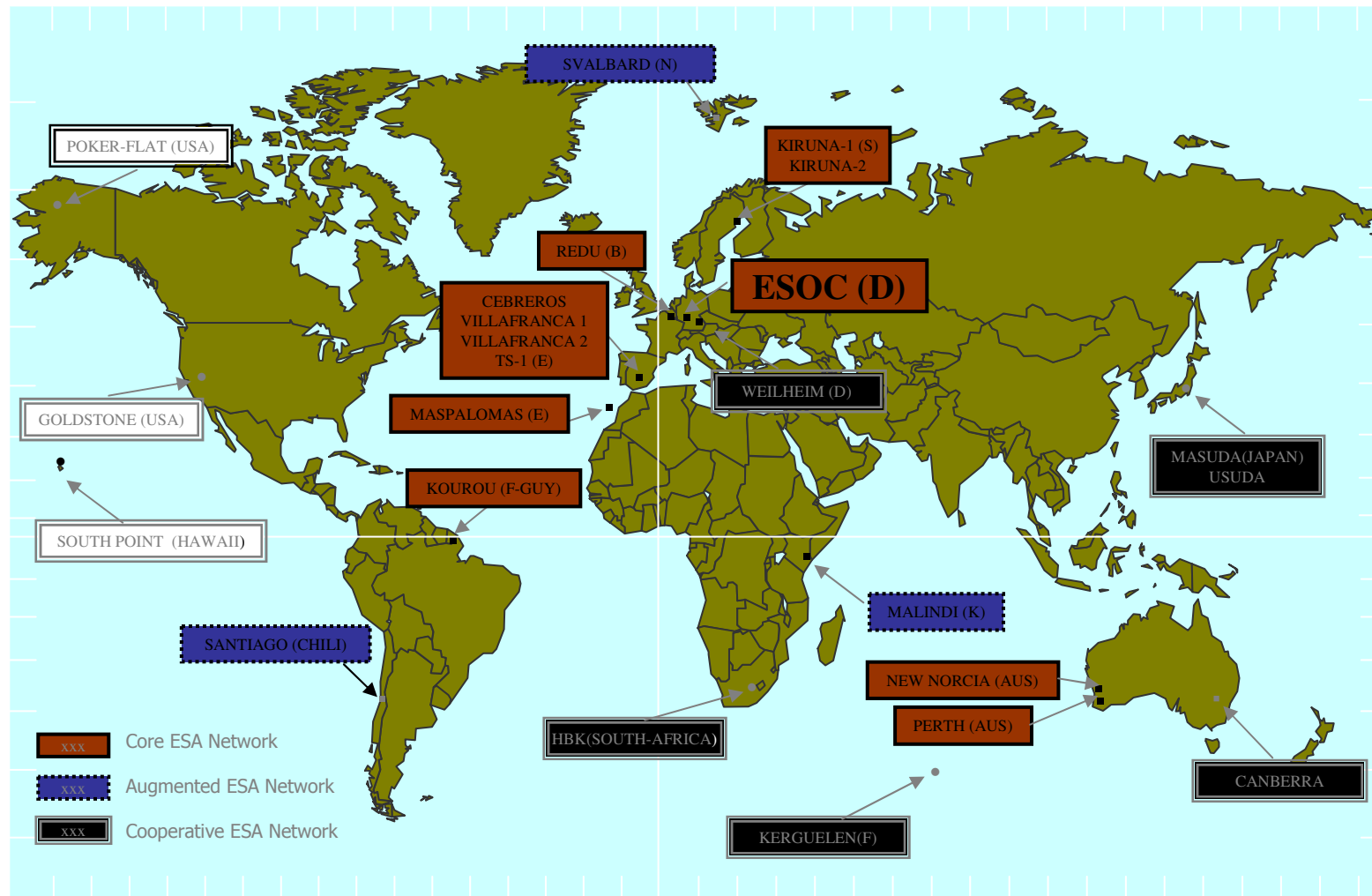
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Development and operation
of ground systems for
satellite operations (control
centres, antennas, data
systems and networks)

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The Ground Stations



Cost of Quality

■ Quality Definition

- **Degree to which a set of inherent characteristics fulfils requirements**

ISO 9000:2000 – Quality management systems –
Fundamentals and vocabulary

- **Fitness for Use**

J.M. Juran and F. Gryna, Juran's Quality Control Handbook.
McGraw-Hill, 1988

Quality is for free (Philip B. Crosby)



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Cost of Quality **cont.**

■ Cost of Non quality

- **Internal failure**

- products or services not conforming to requirements discovered before delivery to customers

- **External failure**

- deficiencies found after delivery of products and services to customers, leading to customer dissatisfaction

■ Cost of Quality

- **Appraisal**

- Control over products and services
- Conformance to standards and performance requirement

- **Prevention**

- All activities to prevent problems from arising in products or services.



■ Total cost of quality

- The total quality costs are then the sum of these costs
- Actual cost of a product /service - potential (reduced) cost given no defects

Quality cost in the Ground Segment

- Space Business implies a lot of appraisal activity,
 - problem management - always required and strictly implemented
 - Independent Reviews
 - Acceptance Tests
- ~ 200 Ground Segment Development problems at system level per mission.
 - An estimates of 4 man-days for management and formal disposition lead to 800 man-days (3.5 man-years) of effort per project
 - The additional cost for correction, re-testing and documentation update are not considered
- Sub-system problems (e.g. MCS) show a comparable number (usually much higher)

Quality cost in the Ground Segment cont.

There's never time to do it right, but always time to do it over

(Meskimen's law of quality):

- Fixing before delivery is good. Avoiding it is much better
- The emphasis on prevention:
 - Effective Processes
 - Tools to ensure process implementation
 - Risk Management
 - Learning from the past and sharing the experience.
- Standardization of process and tools reduce the waste of “reinventing the wheel” and allows for practices comparison (cross fertilization)



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Process standardization

- Not for creativity harnessing

but to avoid

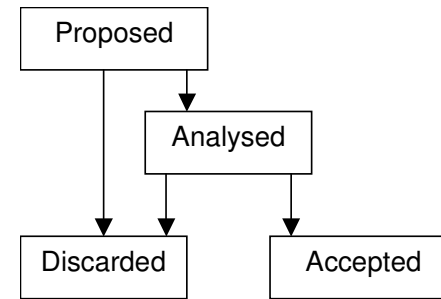
- Risk of a distinct process for every member of the team.



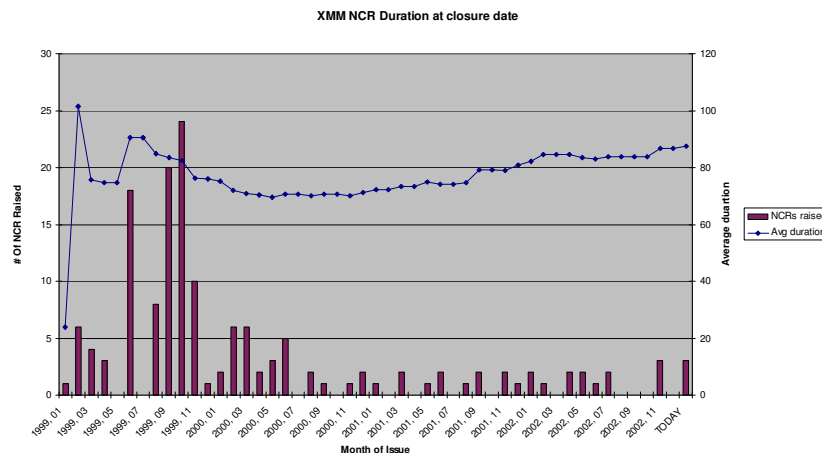
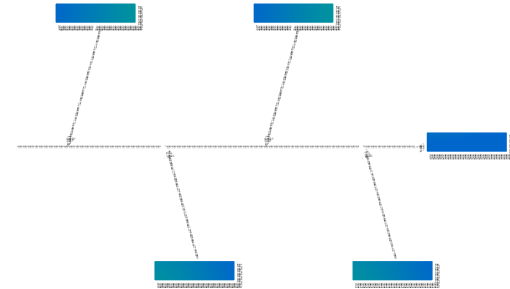
- ◆ Process of proven effectiveness and efficiency
- ◆ Processes to be adapted to the evolving context (organisation, technology, objectives).
- ◆ Need of standardized interfaces for dealing with complex infrastructure (e.g. scheduling for stations)
- ◆ Demonstration of compliance with space standards (and allow easier interaction with other players)

Process Improvement

- Lessons learned
- Root Cause Analysis
- Trend Analysis



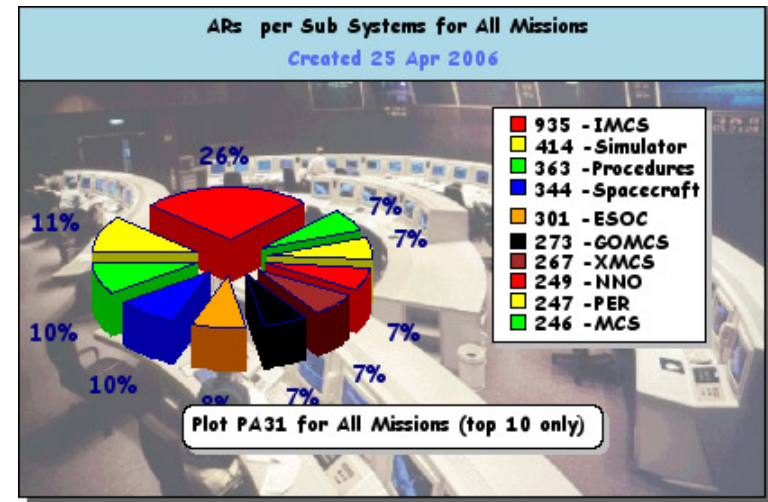
LL Life Cycle



Trend Analysis

Difficult to compare different projects:

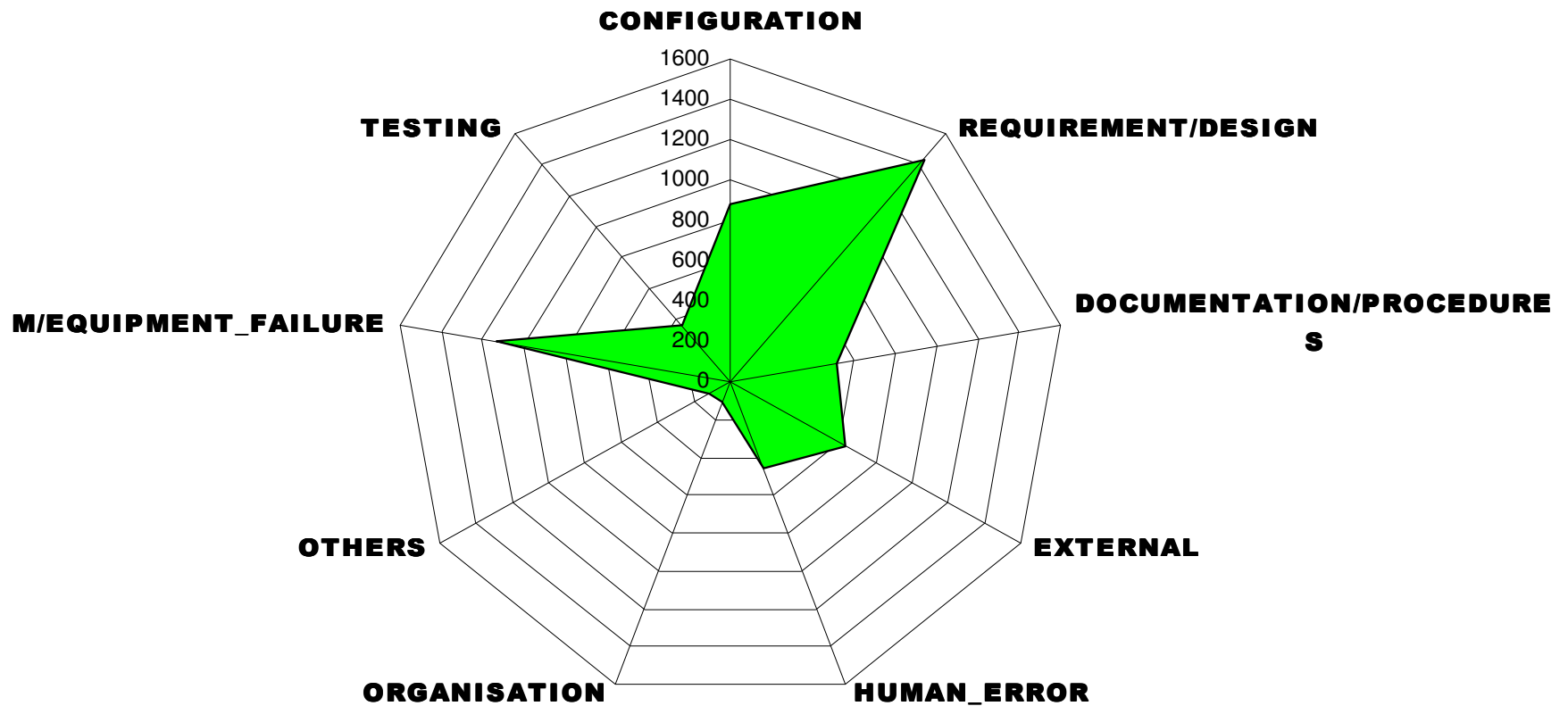
- Different infrastructure maturity
- Technology evolution
- Mission Complexity



- Absolute # of anomalies can not be compared
- Pareto chart helps identifying major contributor processes.

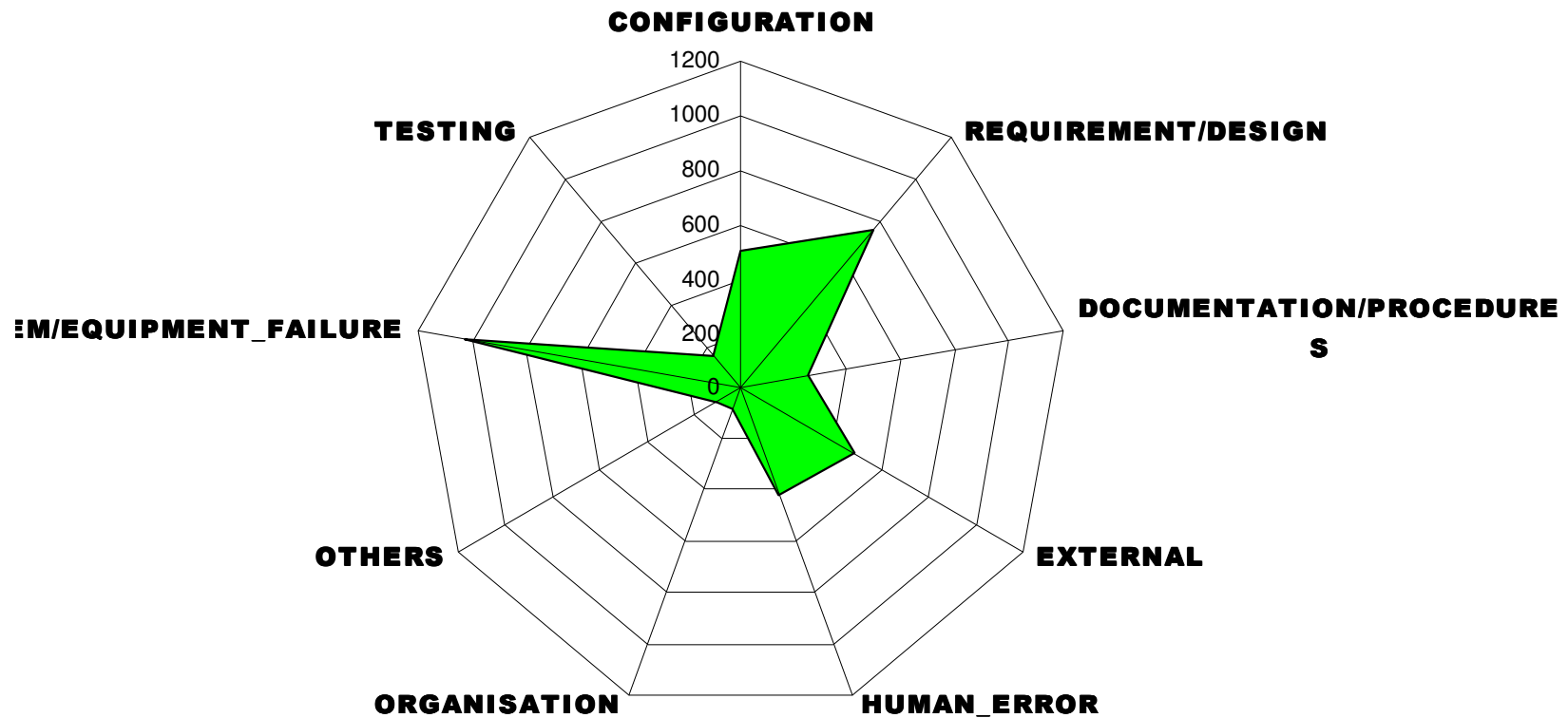
Distribution Analysis

Root Cause Analysis for All Missions OVERALL (5562 reports)



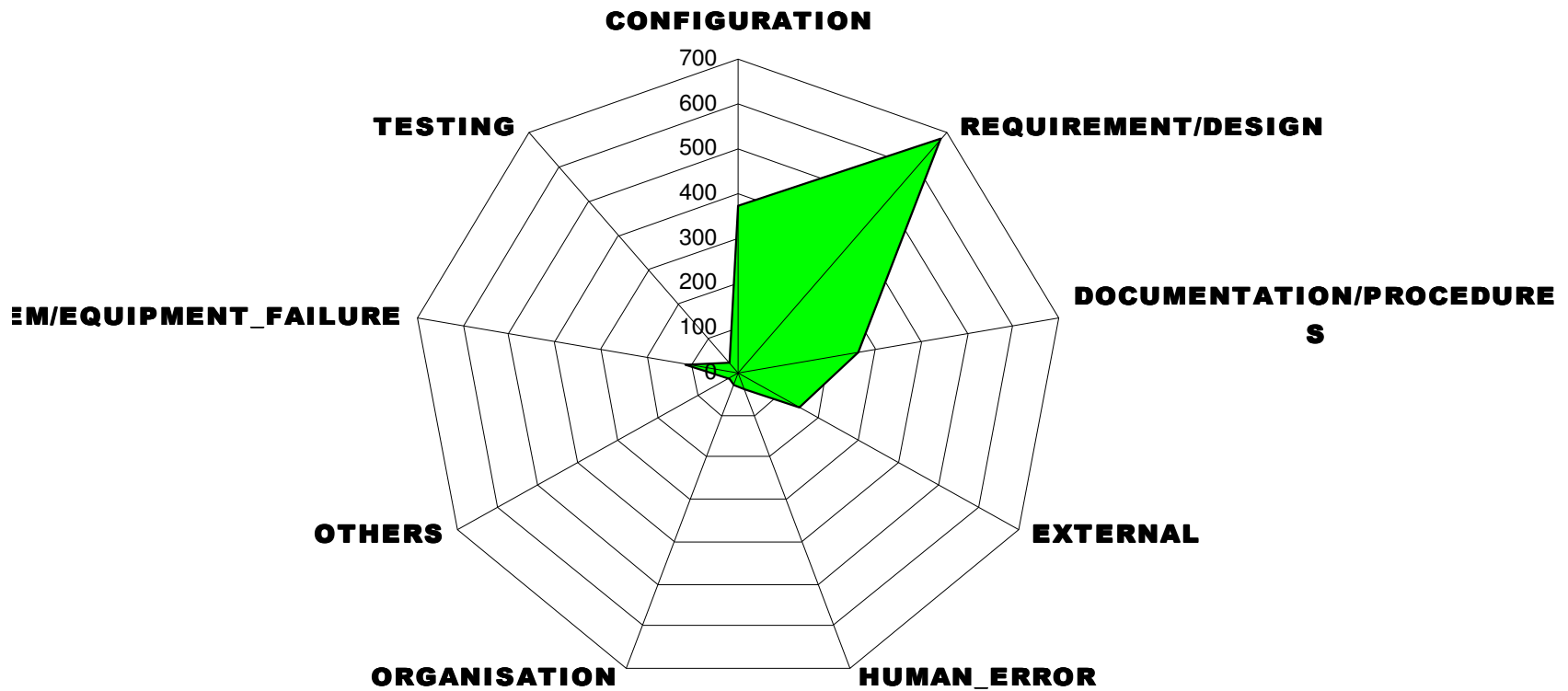
Distribution Analysis

Root Cause Analysis for All Missions OPERATIONS (3782 reports)



Distribution Analysis

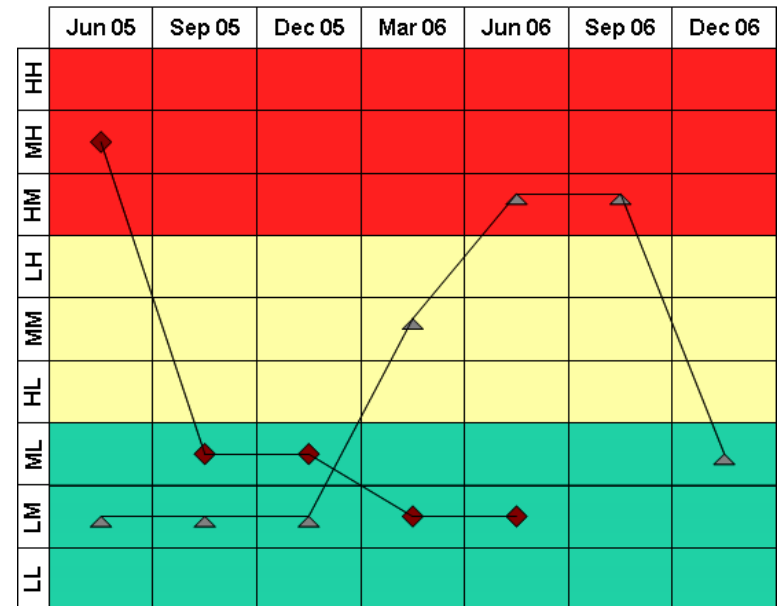
Root Cause Analysis for All Missions DEVELOPMENT (1707 reports)



Risk Management



- Risk Management key element for prevention and non-quality cost reduction
- Program has to prioritize the resource allocation and to accept some level of risks.
- The identification and classification of risk in terms of likelihood and severity allows to perform
 - resource allocation
 - risk acceptance strategy
- Risks in new projects are extremely difficult to be characterized
 - past history may not be completely relevant
 - new architecture
 - technology maturity.



Conclusions

- Cost of non quality strong element in many technical domains
- In OPS the prevention of non-quality cost is pursued via:
 - Common implemented processes
 - Common supporting tools
 - risk management and trend analysis
 - Learning from the past and sharing the knowledge
 - challenging traditional practices
- Difficult to quantify the savings percentage:
 - no mass production and “standard missions”.
 - Development cycle last several years
 - High technology evolution
 - System complexity difference
 - “check” may come several years after the “Plan” phase.



Thank you for your attention



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